CAMBRIDGE SYSTEMATICS

California High Speed Rail Ridership and Revenue Model

Version 2 Model - Processing of California Household Travel Survey Data for Model Calibration and Validation

final

report

prepared for

California High Speed Rail Authority

prepared by

Cambridge Systematics, Inc.

September 2013

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1.0 Introduction

Information on long-distance travel is crucial for interregional and statewide travel forecasting. While long-distance trips account for a small percentage of total trips within the State of California, they account for a significant share of the statewide vehicle-miles of travel (VMT). For example, based on the daily diary information from the recent 2012 to 2013 California Statewide Household Travel Survey (CSHTS), trips to locations more than 50 miles from travelers' residences comprised less than 2 percent of the total daily trip-making, yet were responsible for approximately 30 percent of the statewide VMT.

This report identifies and categorizes approximately 1.5 million daily one-way long-distance trips made by California residents on a typical day, equivalent to an annual per capita average of approximately 8.2 long-distance round trips within the State of California.

A major update of the California High-Speed Rail Ridership and Revenue Model (CHSR^{3}M) was initiated in late 2012. The Version 2 CHSR^{3}M development effort has taken advantage of the daily diary and long-distance recall data collected in the CSHTS performed for the California Department of Transportation (Caltrans). The raw (unexpanded) data have been used for estimation of the discrete choice models for trip frequency, destination choice, and mode choice comprising the CHSR^{3}M.

The Version 2 CHSR^{3}M also will take advantage of the expanded long-distance survey data to estimate control totals for model calibration. Due to the design of the CSHTS daily diary and long-distance recall surveys, information from both surveys have been used to estimate overall daily long-distance trip-making within the State. In addition, information collected as part of the 2011 Harris On-Line Panel Long-Distance travel survey performed for the California High-Speed Rail Authority (CAHSRA) have been used to supplement the long-distance recall data from the CSHTS.

For the Version 2 CHSR^{3}M, long-distance trips have been defined as any trip made to a Traffic Analysis Zone (TAZ) 50 miles or more from the respondent's home TAZ with one end of the trip at the respondent's home. Non-home-based travel occurring more than 50 miles from the respondent's home is not considered, even if the non-home-based trip is more than 50 miles in length. All distances have been calculated as straight line distances between TAZ centroids for consistency with the modeling process. Only intrastate long-distance travel is considered for the CHSR^{3}M.

Four long-distance trip purposes have been defined:

1. **Business travel** includes all travel to locations other than a traveler's normal place of work for business purposes.

2. **Commute travel** includes all travel to a person's regular place of work. Note that a person might work from home three or more days per week, but travel to an assigned office more than 50 miles from their home one or two days per week. Such travel is considered to be commute travel.
3. **Recreation travel** includes all trips made for recreation, vacations, leisure, or entertainment; and
4. **Other travel** includes all trips made for other purposes, such as school, visiting friends or relatives, medical, personal business, weddings, and funerals.

This report describes and summarizes the data sources used to estimate existing long-distance travel within the State of California. The primary data source is the Long-Distance Travel Log (LDTL) component of the CSHTS. However, use of the LDTL without other data sources would have severely underestimated both the total magnitude and relative characteristics of the existing long-distance travel markets. Therefore, other available data sources were used to complete this analysis, including:

- The 2012 CSHTS Daily Diary;
- The Harris On-Line Panel Long Distance conducted in 2011;
- The 2010 U.S. Census; and
- 2010 population synthesis of the California household population.

This report describes the processes used to tabulate the survey data, to identify and rectify biases within the survey data, and to expand the survey dataset to represent the residential population of the State of California.

The residential population of the State accounts for approximately 95 percent of the total population, which was measured at 37.34 million in the 2010 census. The remaining population lives in various group quarter arrangements including institutional arrangements, such as prisons and long-term care facilities; and noninstitutional arrangements, such as college dormitories and military barracks. The group quarter residents were not subject to independent data collection in any of the surveys, but it is safe to assume that this segment of the population accounts for less long-distance travel than the residential population. Therefore, it is appropriate to take the conservative approach to expand the survey data to only the residential population and ignore the travel of the group quarters population. To maintain consistency within this report, all per capita trip rates refer to the rates for the residential population. If overall trip rates were recalculated to include the total population of the State, the average trip rates could be reduced by approximately 5 percent (e.g., from 8.2 annual trips per capita to 7.8 trips per capita), although this reduction would not account for trips actually made by the noninstitutional population.

Significant findings of the analysis include:

- Work-related trip purposes (commute and business trips) account for 26 percent of long-distance trips, while recreational and other trip purposes account for the remaining 74 percent.
- Trip rates show reasonable variations by socioeconomic characteristics. For example, per capita trip rates for high-income households were observed to be more than twice as high as trip rates for low-income households.
- Residents of rural areas account for significantly higher long-distance trip rates (11 annual trips per capita) than residents of urban areas (7.6 annual trips per capita).
- Mode shares for all long-distance trips within California are dominated by auto mode, accounting for 96 percent of all long-distance trips. Even for very long trips over 400 miles, auto mode accounts for two-thirds of all person trips. Airplane mode, which accounts for fewer than 2 percent of all long-distance trips, accounts for 25 to 30 percent of trips over 300 miles. Bus and rail modes each accounts for approximately 1 percent of total long-distance trips for all trip lengths.
- Residents traveling on business trips are much more likely to use airplane mode (6 percent) than residents traveling for other trip purposes (less than 2 percent).
- Residents traveling alone are much more likely to use nonauto modes (7 percent) than persons traveling in groups (2 percent).

The data collected and analyzed for this report have greatly increased our understanding of long-distance travel markets in the State of California. Many of the findings regarding long-distance travel in California have changed since the development of the Version 1 CHSR^{3}M in 2006-2007. The Version 1 model was calibrated to estimated long-distance travel for a 2005 base year with estimates of the 2005 long-distance travel based on a combination of 1995 American Travel Survey (ATS), 2000 Census Transportation Planning Package (CTPP), and 2001 CSHTS data. Changes in estimates of intra-California long-distance travel include:

- Commute work trips were estimated to account for approximately 40 percent of statewide long-distance travel in 2005. The expanded 2012-2013 CSHTS data indicated that long-distance commute work trips now account for about 16 percent of statewide long-distance travel. One reason hypothesized for the change in long-distance commute travel is that the "dot-com" boom in the Silicon Valley was strong during the 1995 through 2001 period when the data for estimating 2005 long-distance travel was collected.
- Air travel was previously estimated to account for approximately 50 percent of long-distance travel for trips over 300 miles. The expanded 2012-2013 CSHTS data indicates that air travel now accounts for approximately

27 percent of long-distance travel for trips over 300 miles. The decrease in the dot-com boom, the changes in air travel due to 9/11, and the 2008 recession would all contribute to the decrease in air travel.

- Significantly fewer very long-distance trips (over 300 miles in length) have been estimated based on the 2012-2013 CSHTS data than were estimated for 2005 for the Version 1 model. Again, the changes in air travel due to 9/11 and the 2008 recession could contribute to the decrease.

While typical, one-day travel diaries can provide some useful information regarding long-distance travel, they are an inefficient source of information for the detailed analysis of long-distance travel. Since long-distance travel is a relatively rare occurrence for most households – the average person makes approximately nine long-distance round trips per year – most households will not report any long-distance travel in a survey collecting travel data for a single travel day. In fact, only five percent of households participating in the CSHTS reported any long-distance trips in their daily diaries.

This report describes how three recent surveys performed in California have been used to provide an overall picture of long-distance travel within the State. The three surveys are the 2011 Harris On-Line Panel Long-Distance survey performed for the CAHSRA and the CSHTS Daily Diary and Long-Distance Travel Recall Surveys.

This report is divided into sections. Following this introductory section, Section 2.0, provides brief overviews of each of three recently completed surveys of long-distance travel in the State of California. Section 3.0 describes how data from each of the surveys were combined and used to provide an overall picture of long-distance travel made by California residents within the State, and to expand the survey data to represent long-distance travel for the entire population of the State of California. This section includes documentation of recommendations by the CAHSRA Peer Review Panel (PRP) and describes the results of analysis to address the concerns of the PRP. Section 4.0 uses tabulations and graphical presentations to present the results and analysis of the expanded survey dataset. This section includes presentations of trip generation rates, trip length frequency distributions, and mode shares; all of which are classified and cross-classified by variables, such as socioeconomic characteristics, trip purposes, and geographic locations. Section 5.0 presents descriptions of next steps, including use of the survey database to estimate and calibrate Version 2 of the CHSR^{3}M and efforts to confirm the validity of the survey dataset by comparison to other available data sources.

2.0 Background on the Three Travel Surveys

This section provides overviews of the three travel surveys: the CSHTS daily diary survey, the CSHTS LDTL recall survey, and the Harris on-line panel long-distance travel recall survey.

2.1 2012-2013 CSHTS DAILY DIARY SURVEY

The CSHTS daily diary survey was a comprehensive household travel survey that collected daily travel from all members of each respondent household. The survey collected travel information from 42,431 California households using a daily travel diary as the primary collection tool. Multiple data collection methods were employed, including computer-aided telephone collection, on-line data entry by respondents, and mail-back of survey forms. A stratified sampling procedure was used to ensure that the number of surveys collected from each county exceeded specified minimum quotas.

2.1.1 Data Collection and Analysis Process

Travel data were collected for each member of a respondent household during the travel day appointed for the household. The travel diary was designed to collect information necessary to calibrate and validate either trip-based or activity-based travel models. The data included characteristics of each respondent household, the household members, the vehicles owned by the household, the places visited, activities performed at those places, and modes of travel between places visited. More than 3,600 households declined to report household income and were dropped from the database used for the analysis of long-distance travel. The remaining 38,787 households with all socioeconomic data reported were used to estimate long-distance travel behavior for the diary day.

While a one-day travel diary is well suited for collecting typical travel data, it is not the ideal instrument for collecting long-distance travel data. Even with a sample the size of the CSHTS, more than 100,000 persons in the 38,787 households, a single-day diary collects long-distance travel data for a very small proportion of travelers and households. In fact, analysis of the results of the CSHTS daily diary survey found that only 5 percent of respondent household made a long-distance trip on the appointed diary date. It is clear that a survey mechanism that does not collect useful information from 95 percent of survey respondents is a very inefficient use of valuable resources.

A second issue with using the daily diary for the analysis of long-distance travel data is that it is difficult or impossible to determine long-distance trip purposes for many of the reported trips. Since daily diaries are designed to collect information for only the assigned travel day, it is often impossible to determine the true purpose for long-distance travel. For example, a person may travel for a business meeting scheduled for the day following the assigned travel day. That traveler's final trip (or tour) on the assigned travel day may end at a hotel, leaving the true purpose of the trip unreported.

Nevertheless, the strength of the daily diary survey for the analysis of long-distance travel is that it provides a good mechanism for identifying all long-distance travel completed by members of respondent households on the assigned travel day. Thus, it is a very strong tool for validating overall long-distance travel estimated using data from long-distance recall surveys.

In our analysis, long-distance trips were estimated from the daily diary data using a process similar to determining tours for tour-based travel models:

1. A TOUR was defined by listing all PLACES visited between two stops at the HOME location;
2. For each TOUR, the PLACE farthest from the HOME location (based on straight line distances) was determined;
3. If the farthest place visited was 50 miles or more from the HOME location, the location was identified as the long-distance DESTINATION;
4. Each long-distance DESTINATION determined from the above three steps defined an end-point for two, one-way long-distance trips (since the traveler, in the case defined by the above three steps, left and returned home on the assigned travel day);
5. For trips that began or ended the travel day at a location other than HOME, the trip was counted as a single one-way long-distance trip if the non-HOME location was 50 miles or more from HOME; and
6. Long-distance trips that included a stop outside the State of California were not counted as long-distance trips, even if the TOUR defining the long-distance trip included a stop within California that was 50 or more miles from HOME.

This process was defined to avoid double-counting long-distance trips from the daily diary and to be as consistent as possible with the long-distance travel data reported in the recall surveys. The goal of the process was to "link out" intermediate stops for incidentals such as gas or food. In some cases, the process incorrectly identified the true long-distance destination. For example, suppose a person traveled to a specific location for a business meeting and made a noontime visit to a restaurant farther from HOME than the location of the business meeting. The restaurant location would have been identified as the long-distance trip DESTINATION.

The above analysis process identified 3,210 long-distance trips completed by 3,199 persons (i.e., 11 persons made more than one long-distance trip on their diary day). A significant portion, 53 percent, of the long-distance travel involved overnight stays, so those travelers were credited with completing one-half of a long-distance round trip. Therefore, the 3,210 long-distance trips accounted for 4,713 one-way trips, or the equivalent of 2,356 long-distance round trips. Since multiple household members traveled together to a significant number of the identified long-distance locations, 1,201 of the long-distance person trips were consolidated into larger group trips. Thus, the survey identified long-distance trips to 2,009 "unique" locations. In all, long-distance trips were identified for 1,965, or 5 percent of the 38,787 households included in the CSHTS data used for the analysis.

The surveyed long-distance trips were expanded to represent long-distance travel for all California households. The expansion factors were based on geographic and demographic characteristics of the surveyed households as compared to those characteristics for all households in California. After the expansion factors were applied to the CSHTS daily diary database, over 1.5 million one-way long-distance trips were estimated to be made by California residents on an average day. Based on expanded results from the CSHTS data, the long-distance trips account for approximately two percent of all intrastate trips made by California residents.

The 1.5 million daily one-way long-distance trips equate to an average of 8.2 annual intrastate long-distance round trips per capita for California household residents. In comparison, a National Passenger Transportation Survey (NPTS) Brief from 2006[1] estimated the national average of 9.4 annual long-distance round trip rate per capita; for the Pacific region the annual average was 8.7 long-distance trips per capita. When interstate and international long-distance trips reported in the CSHTS daily diary also are included in the analysis, the average round trip rate is 8.6 annual long-distance trips per capita, which is almost identical to the value reported in the NPTS for the Pacific region.

2.1.2 Summary of Findings Regarding Usefulness of CSHTS Daily Diary Data for Long-Distance Travel Analysis

The CSHTS Daily Diary data provide a good basis for determining the overall amount of intrastate long-distance travel made by California residents. However, even though the CSHTS dataset includes information from 38,787 households, long-distance trip-making is such a rare phenomenon that making estimates of variations in trip rates by geographic region of the State or different socioeconomic strata has not been performed. In addition, since the diary

[1] NPTS Brief, March 2006, U.S. Department of Transportation Federal Highway Administration, http://nhts.ornl.gov/briefs/LongDistanceTravel.pdf, accessed July 30, 2013.

covered only one day of travel, it is not possible to reliably determine the purposes of the long-distance trips reported in the diary.

2.2 2012-2013 CSHTS LONG-DISTANCE TRAVEL RECALL SURVEY

With the knowledge that the understanding of long-distance travel is critical to the analysis and planning for many upcoming projects in California, the CSHTS included a supplemental survey to collect more long-distance travel data than would be available from the CSHTS Daily Diary survey. The LDTL was an optional survey that requested long-distance travel performed by the members of the respondent households during the eight weeks preceding the assigned travel day. The longer survey period (56 days, as compared to 1 day for the daily diary) greatly increased the amount of long-distance travel data available for analysis.

2.2.1 Data Collection and Analysis Process

The LDTL was designed to reduce respondent burden by requesting information deemed relevant for most planning studies: trip origin and destination, trip purpose, group size (total and household members), and the main mode of travel used on the trip. Respondents were instructed to record this information for all long-distance trips completed during the eight-week reporting period to places 50 miles or more from their home. One recall survey form with spaces for up to eight long-distance trips was provided for each household member. Respondents were instructed to record outbound and return trips separately, and to record details for trips in excess of the eight spaces available on the travel log on a separate sheet of paper.

Completion of the LDTL was not required for a survey collected via the daily diary to be considered to be complete. As a result, long-distance travel data were provided by only about one-half of CSHTS respondent households. The differential response rate dictated the calculation of separate expansion factors for estimating long-distance travel characteristics for the full population of California. However, even though the LDTL was optional, data for a much greater number of long-distance trips were collected via the LDTL than were collected via the daily diaries. The LDTL collected data for 32,641 long-distance person trips completed by 22,555 individuals from 12,183 households. Another 9,834 households completed the LDTL, but indicated either no long-distance trips or long-distance trips only to non-California locations. Approximately nine times as many trips to unique locations, 18,023, were identified in the LDTL as were identified in the daily diary. This occurred in spite of the fact that the LDTL was completed by only one-half of the CSHTS households. The larger number of trips to unique locations resulted in a much richer database for analyzing and understanding long-distance travel in California.

When the 32,641 long-distance person trips reported in the LDTL were initially expanded to represent the entire population of California, approximately 680,000 daily one-way long-distance trips, or an average of 3.6 annual long-distance round trips per capita, were estimated. By comparison, this estimate accounts for less than one-half the 1.5 million daily long-distance trips – or 8.2 annual long-distance round trips per capita – calculated using the data derived from the CSHTS daily diary. The analysis and processes used to account for and correct these differences are documented in the following sections of this report.

2.2.2 Summary of Findings Regarding Usefulness of CSHTS Long-Distance Recall Survey Data for Long-Distance Travel Analysis

The LDTL provided a rich database for determining long-distance trip purposes and the destination and main mode choice characteristics intrastate long-distance travel made by California residents. Since discrete choice models of trip frequency, destination choice, and mode choice were being developed for the CAHSR^{3}M, the unexpanded trip data could be used to estimate model forms and coefficients. Thus, the fact that the total amount of long-distance travel based on the LDTL was less than one-half the amount of travel estimated using the daily diary did not preclude the use of the LDTL data for model estimation. However, procedures to adjust the LDTL data to reflect all intrastate long-distance travel had to be developed for the data to be useful for final calibration of the CAHSR^{3}M.

The initial analysis of the LDTL data revealed several survey design issues that had to be addressed:

- The LDTL did not include a "repetition frequency" question, which would have allowed respondents who made multiple long-distance trips to the same location via the same travel mode to quickly report the repeated trips. An analysis of the responses, along with the number of LDTLs with exactly eight trips, suggested that respondent fatigue, coupled with a lack of understanding of the need for respondents to report all long-distance travel, was an important issue.
- The LDTL required respondents to remember and report travel completed as far back as eight weeks prior to their assigned travel day. The recall survey was subject to memory lapses resulting in underreporting of long-distance trips.
- Many respondents failed to record both directions of travel. On average, for every outbound trip, only 65 percent of return trips were recorded.
- The long-distance recall survey was not subject to the same rigorous process to make sure that all trips completed by all household members were reported by the survey respondent.

- Since completion of only the CSHTS Daily Diary was required for a survey to be considered to be complete, only about one-half of the respondent households completed the LDTL. Household characteristics and trip-making characteristics for households completing and households failing to complete the LDTL were different.

Since the data from the LDTL were the primary data for the estimate of total long-distance travel made by California residents, each of the issues outlined above had to be addressed before reasonable estimates of travel could be produced.

2.3 2011 HARRIS ON-LINE PANEL LONG-DISTANCE SURVEY

The Harris on-line panel long-distance survey was performed for the CAHSRA in May and June 2011, in an effort to collect information for corroborating trip rates and shares of trips by trip purpose forecast using the Version 1 CAHSR^{3}M. The survey was designed, pilot tested, performed, and summarized over a two-month period in order to meet a schedule imposed on the production of ridership forecasts for the CAHSRA 2012 Business Plan.[2] The survey design[3] was similar to the CSHTS long-distance recall survey, in that travel over the previous eight-week period was requested. However, there were several distinct differences:

- Survey respondents were drawn from established on-line panels that respond to selected surveys in order to accrue credit for awards and prizes.
- Demographic information on the panelists, such as age, sex, household size, and household income, was obtained from panelists' on-line panel registration information. Worker status of the survey respondents was collected later to aid in the socioeconomic classification of the participants.
- Due to the need to limit response time for the survey, only the destination city or zip code, rather than detailed address information, was requested for each trip.

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[2] Revised 2012 Business Plan, April 2012, California High Speed Rail Authority. http://www.hsr.ca.gov/docs/about/business_plans/BPlan_2012_rpt.pdf, accessed July 30, 2013.

[3] California High Speed Rail 2012 Business Plan Ridership and Revenue Forecasting, April 22, 2012, prepared by Cambridge Systematics, Inc. for the California High Speed Rail Authority (http://www.hsr.ca.gov/docs/about/business_plans/BPlan_2012Ch5_RidershipRevForecasting.pdf), accessed July 30, 2013).

- Also, due to the need to limit the response time for the on-line survey, respondents were requested to provide a repeat frequency for multiple trips made to the same destination for the same purpose and using the same mode during the eight-week recall period. This shortcut resulted in the finding that many long-distance trips are repeated on a regular basis.
- The survey collected long-distance travel information only for the panel member rather than for all household members. This allowed survey respondents to provide information about their own long-distance travel during a single Internet session without requiring interviews of other household members.
- The survey panel included only adult household members.
- The survey was conducted over a two-month time period, rather than over a complete year.

2.3.1 Data Collection and Analysis Process

The two-month time period covered by the survey (essentially April and May 2011) represented an "average" time of year when most employed residents were working and most students were in school. More long-distance trips would be expected during the summer months for vacation travel, and fewer long-distance trips would be expected during the winter months. The survey timeframe included a major holiday weekend (Memorial Day) that is often associated with recreational weekend travel. The inclusion of one major holiday weekend was appropriate for the two-month survey timeframe since almost any two-month time period during the calendar year includes one such major holiday weekend.

The 2011 Harris Panel survey collected useful long-distance travel information for 11,986 California residents. These residents reported making over 25,000 one-way long-distance trips during the two-month survey recall period. This total included over 11,200 one-way long-distance trips to unique locations. Each unique trip was factored by the reported repeat frequency over the previous two months. The average trip repetition frequency reported by the Harris Panel survey respondents was 2.23 repetitions for each trip. The repeat frequency varied significantly by trip purpose (commute trips had the highest repeat frequency) and trip length (shorter trips had higher repeat frequencies than longer trips). Based on the reported trips, coupled with repeat frequencies and adjustments for household members accompanying the survey respondents on trips, the Harris survey identified approximately 1.13 million daily long-distance trips within the State of California, or an annual average of 6 long-distance intrastate round trips per capita. This average trips rate is approximately 65 percent higher than the trip rate calculated for the CSHTS LDTL, but 30 percent lower than the trip rate calculated for the CSHTS Daily Diary.

2.3.2 Summary of Findings Regarding Usefulness of 2011 Harris Panel Long-Distance Survey Data for Long-Distance Travel Analysis

The 2011 Harris Panel survey was designed to collect long-distance travel characteristics of adult California residents. The original intent of the survey was to validate long-distance trip-making forecast using the Version 1 CAHSR^{3}M. With limited time and resources available, and with the knowledge that a more comprehensive statewide household survey would not be ready for another 12 months, the Harris Panel survey was used as a stop-gap measure to corroborate long-distance trip frequency, shares of trips by trip purpose, average trip lengths, travel group sizes, and mode shares.

The following issues impact the usefulness of the 2011 Harris Panel survey data for long-distance travel analysis:

- The survey was not a random sample of California residents since respondents were drawn from an established on-line panel that responds to selected surveys in order to accrue credit for awards and prizes.
- Long-distance trip information was collected for only the respondents; not all members of the respondents' households. While adjustments were made for household members accompanying respondents on their reported trips, trips made by other household members independently of the survey respondents were not recorded.
- The survey did not collect detailed origin and destination location information.

The 2011 Harris Panel survey data provide one information for one very important variable that is missing from the LDTL and can be used for long-distance travel analysis: an estimate of repeat frequency for long-distance trips. The following section describes how this information was combined with the data collected via the 2012-2013 CSHTS Long-Distance Recall survey to improve estimates of total intrastate long-distance travel made by California residents.

3.0 Methods for Expanding and Adjusting the 2012-2013 CSHTS Long-Distance Recall Survey

The previous section provided background on the three sets of survey data available for estimating total intrastate long-distance travel made by California residents. Issues were identified with each of the surveys that limited the usefulness of the data for the estimates of total travel. However, by combining information from each of the surveys, a reasonable estimate of the total travel can be made:

- The 2012-2013 CSHTS Daily Diary data provide a reasonable estimate of the total average daily intrastate long-distance trips made by California residents. The estimated amount of daily long-distance trip-making corresponds closely with the estimate of long-distance trip-making from the NPTS. The estimate can be used to adjust for underreporting of long-distance trips in the 2012-2013 CSHTS Long-Distance Recall survey.
- The 2012-2013 CSHTS Long-Distance Recall survey data provide the most complete data regarding long-distance trips by trip purpose, long-distance trip travel flows, and long-distance trip mode shares.
- The 2011 Harris Panel survey data provide important information regarding the repeat frequency for long-distance trips. This information can be used to adjust reported trips by trip purpose and trip length in the 2012-2013 CSHTS Long-Distance Recall survey.

Three basic steps comprised the process used to adjust the 2012-2013 CSHTS Long-Distance Recall survey:

1. Only information from one direction of travel was used for the analysis. This removed the issue that 35 percent of respondents reported information only for outbound trips, and a much smaller number reported information only for return trips. For total intrastate long-distance trip-making, symmetry of travel was assumed. This step was a simple, straightforward adjustment.
2. An imputation procedure was developed to account for repeat frequency. This procedure randomly assigned repeat frequencies from the 2011 Harris Survey on LDTL data based on trip purpose, trip distance, and traveler socioeconomic data.

3. Distance-based adjustment factors based on the 2012-2013 CSHTS Daily Diary data were applied to adjust for remaining differences between overall trip rates from the adjusted LDTL data.

3.1 EXPANSION PROCESS

While the survey was collected in 2012 and 2013, the survey was factored to match 2010 socioeconomic characteristics of California households. The 2010 socioeconomic characteristics were summarized from a synthesis of the California population produced by HBA Specto as part of their work on the California Statewide Travel Demand Model (CSTDM) for Caltrans.

Surveyed trip records were expanded to represent over 12.58 million households in the State of California by comparing the numbers of observed records (completed surveys) to the number of households within the State. A four-dimensional, cross-classification scheme resulted in 99 possible socioeconomic strata. The four dimensions and strata were the following:

1. Household size: 1, 2, 3, or 4+ persons per household.
2. Worker per household: 0, 1, or 2+ workers per household.
3. Vehicles per household: 0, 1, or 2+ vehicles per household.
4. Annual household income range for 2010 for the respondent's household. Low income was defined as less than $45,000 per year; medium income was defined as $45,000 to 89,999 per year; and high income was defined as $90,000 and over.

The expansion factors also were stratified by five geographic regions defined for the State. Four of the regions were defined by the major metropolitan planning regions: the Los Angeles metropolitan area as defined by Southern California Association of Governments (SCAG) region, the San Francisco Bay area as defined by the Metropolitan Transportation Commission (MTC) region, the San Diego Association of Governments (SANDAG) region, and the Sacramento Area Council of Governments (SACOG) region. The remainder of the State comprised the fifth geographic region.

The numbers of surveyed records for each cell of the cross-classification was tabulated for the LDTL survey dataset (22,017 households). For cells with very few observed households, cells were aggregated to maintain at least 15 observations for expansion purposes. Expansion factors for each cell of the cross-classification were determined by dividing the number of households in the population synthesis by the number of survey households. The synthesized population for 2010 that had been developed for the CSTDM was used for the expansion. Thus, in effect, trip-making characteristics from 2012 and 2013 have been used to estimate long-distance trip-making in 2010.

For reference purposes, expansion factors varied from 102 to 4,427 with a weighted average expansion factor of 572. The wide range for the expansion

factor resulted from several factors, including intentional sampling procedures to achieve minimum quotas in geographical regions. The intentional oversampling of smaller regions resulted in smaller expansion factors being calculated for those regions, especially in comparison to the two largest regions in the State: SCAG and MTC regions.

3.2 CORRECTION PROCESS

3.2.1 Advice from Peer Review Panel

The Peer Review Panel was consulted frequently to present findings from the surveys, and to solicit advice to improve the reliability of the results. Following a presentation of preliminary findings from the interim survey dataset, the Peer Review Panel provided advice and requested further detail and clarification, including the following subjects:

- Add tables with cumulative shares in trip distance bins (e.g., 50 to 75 miles, 75 to 100 miles, etc.) for all trips, by mode, by income group, etc.
- Investigate the long-distance trip frequency distribution to understand the impact of the limited space on the long-distance survey travel log (eight trip cut-off).
- Investigate and document how often the return trip was or was not reported.
- Investigate the impact of the fact that only 51 percent of households completed the LDTL. Quantify the differences between the two groups and investigate to determine if there is any link with the response burden in the daily diary.
- The Peer Review Panel agreed with the reasons cited for the underreporting of long-distance trips and advises that it is necessary to use a hazard-based approach to correct for the censored data, in combination with an analysis of nonreporting of long-distance trips. A comparison with the National Cooperative Highway Research Program (NCHRP) report would be useful.
- The Peer Review Panel agreed with the procedure proposed to correct for the lack of data regarding trip repetition frequency. They also recommended that missing long-distance trips should be accounted for with a process integrated into the analysis.
- The final report should clarify the units used (i.e., do trips/day = one-way trips; journey = roundtrips); in-state trips only.
- The airline passenger ticket sample should be used to validate airplane mode.

All of these requests and recommendations of the Peer Review Panel were addressed in the analysis, adjustment, data expansion, and tabulation of the final survey dataset documented in this report.

3.2.2 Imputation of Repeat Trips

The average trip repetition frequency from the LDTL, which did not include a trip repetition frequency question, was 1.2 repetitions for each trip. This information was estimated by summarizing the numbers of long-distance trips in the LDTL, which were made by each respondent to the same location, for the same trip purpose, and by the same mode. In comparison, the average trip repetition frequency summarized from the 2011 Harris Panel survey, which did include a question regarding trip repetition frequency, was 2.2 repetitions for each trip.

In order to adjust for the underreporting of repeat trips in the LDTL data, a procedure was implemented to replace the trip repetition frequency information summarized from the LDTL data with imputed trip repetition frequency derived from the data reported by the Harris Panel survey. The 2011 Harris Panel data showed that trip repetition frequency was correlated with trip purpose (commute trips have the highest repetition frequency) and trip length (shorter trips have the higher repetition frequency than longer trips). In addition, for the commute trip purpose it was clear that household income was important for estimating trip repetition frequency. Double-counting of reported repeat trips in the LDTL data was averted by removing the reported repeat trips so that only "unique" long-distance trips were included in the database. The imputation process was then completed by randomly assigning a repeat frequency rate from the Harris Survey data based on the trip purpose; trip length; and, in the case of commute trips, income group of the respondent.

Table 3.1 shows the impact of the trip repetition frequency imputation process. The table column "Reported Repetition Frequency (LDTL)" summarizes the reported repeat trips during the eight-week recall period from the LDTL, and the table column "Imputed Repetition Frequency (Harris)" summarizes the results after application of the imputation process. The imputed repetition frequency rates are substantially higher for commute trips than for the other trip purposes. The expanded data in the last two columns show the results for each of the categories before and after the implementation of the imputation process. The imputation process increased the number of trips for all trip purposes with the biggest impact on the commute trip purpose. The average repetition frequency reported for commute trips in the LDTL survey was two repeats per unique trip; whereas, the average repetition frequency reported for commute trips in the Harris Survey was 15 repeats per unique trip. The imputation process increased the number of commute trips from 23,250 (or 3 percent of total long-distance trips) to 87,285 or (15 percent of total long-distance trips).

Table 3.1 Impact of Trip Repetition Frequency Imputation on Long-Distance Trips

Trip Purpose	Distance Range (Miles)	Income Range(s)	Reported Repetition Frequency (LDTL)[1]	Imputed Repetition Frequency (Harris)[1]	Expanded Daily Long-Distance Trips	
					Before Imputing	After Imputing
Commute	50-75	Medium, High	2.5	24.5	11,200	115,130
	50-300	Low	1.2	6.2	1,190	5,040
	75-300	Medium	1.6	18.2	2,660	31,970
	75-300	High	1.9	6.0	6,560	20,960
	Over 300	All	1.4	1.4	1,640	1,470
	All (Over 50)	All	2.0	15.0	23,250	174,570
	Percent of Total Long-Distance Trips				3%	15%
Business	50-75	All	1.2	2.2	23,790	44,890
	75-100	All	1.2	1.9	13,740	21,080
	100-150	All	1.1	1.8	12,170	18,810
	150-300	All	1.1	1.7	8,980	13,490
	Over 300	All	1.1	1.6	11,370	16,080
	All (Over 50)	All	1.2	1.9	70,050	114,350
	Percent of Total Long-Distance Trips				10%	10%
Recreation & Other	50-75	All	1.2	1.9	190,560	318,920
	75-100	All	1.2	1.7	126,370	185,510
	100-150	All	1.1	1.5	120,410	164,590
	150-300	All	1.1	1.4	92,440	119,760
	Over 300	All	1.1	1.2	60,900	68,890
	All (Over 50)	All	1.1	1.6	590,680	857,670
	Percent of Total Long-Distance Trips				86%	75%
All Purposes					**683,980**	**1,146,590**

Source: Cambridge Systematics, Inc.

[1] During the 8-week recall period.

3.2.3 Correction for Missing Trips

After the imputation process was implemented, the adjusted trips were expanded to represent the total intrastate long-distance trip-making by California residents. The adjusted, expanded trips summed to approximately 1.15 million daily intrastate long-distance one-way trips, or an average of 6.1 annual long-distance round trips per capita. This annual round trip rate per

capita was still significantly lower than the 1.5 million daily long-distance trip (or 8.2 annual round trips per capita), calculated from the CSHTS daily diary data.

The cause of the difference was surmised to be a result of underreporting of trips for the various reasons described previously (i.e., the provision of only eight spaces on the LDTL forms for long-distance trips, forgotten trips due to the eight-week recall period, and differences between the respondents reporting long-distance travel and respondents who elected to not complete the long-distance recall survey).

It was not possible to isolate these sources of underreporting independently in order to determine separate adjustments for each component of underreporting. However, when the expanded, adjusted LDTL dataset and the expanded long-distance trips from the CSHTS daily diary were tabulated and compared by trip distance, it was clear that most of the trips missing from the imputed/expanded LDTL dataset were shorter trips, particularly trips between 50 and 200 miles. For the trip lengths more than 200 miles, almost identical number of trips was estimated for the two expanded datasets. This finding appears to be logical since shorter trips are more likely to be forgotten with the recall survey methodology, especially for trips made more than a month prior to the reporting date and trips made by household members other than the survey respondent.

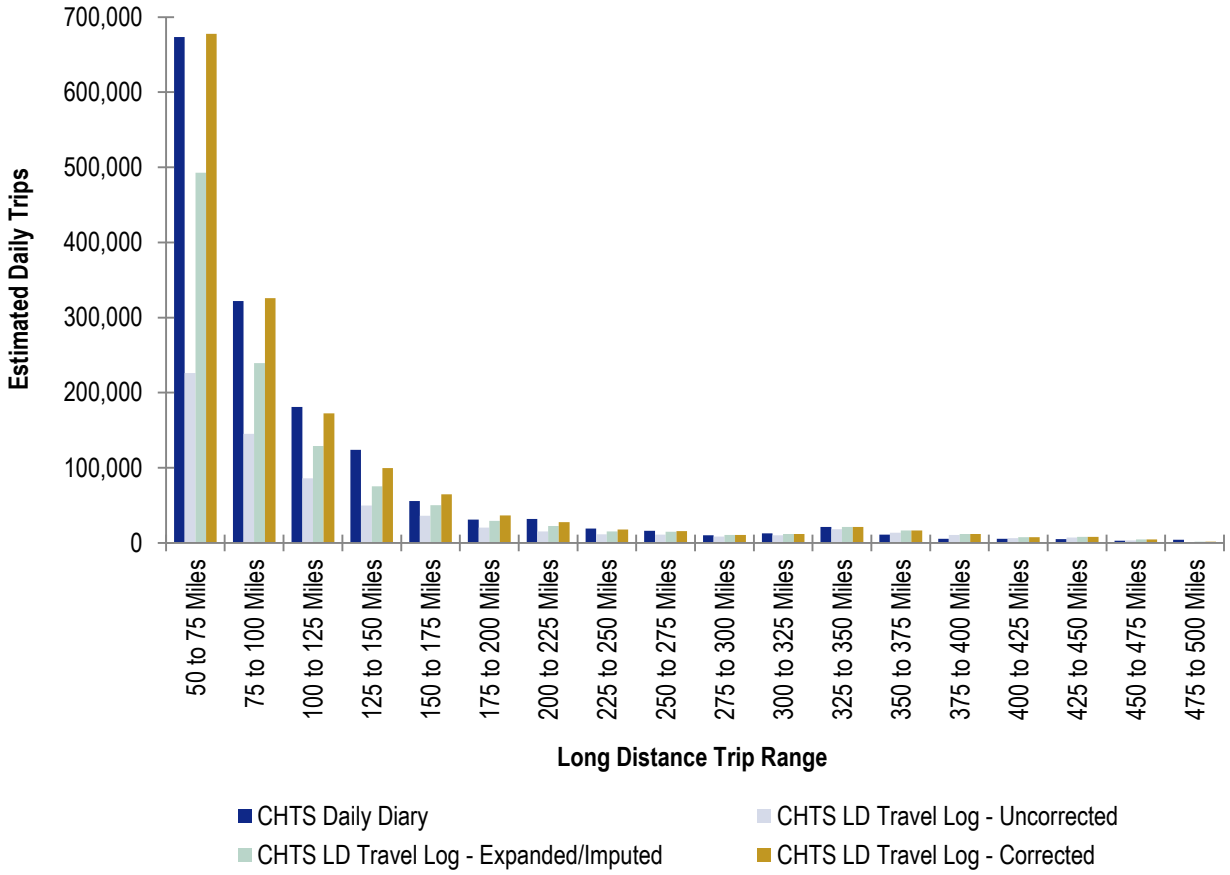
Adjustment factors stratified by 25-mile groupings were calculated to correct the differences between the CSHTS daily diary and the CSHTS LDTL survey. Trips between 50 and 75 miles were increased by 37.5 percent to correct the difference, and decreasing adjustment factors were applied for increasing distances up to 275 miles in length. No adjustment factors were applied for trips over 275 miles in length. The adjustment factors applied to correct for missing trips are summarized below:

- For trips between 50 and 75 miles in length – adjustment factor = 1.375;
- 75 to 100 miles = 1.36;
- 100 to 125 miles = 1.34;
- 125 to 150 miles = 1.32;
- 150 to 175 miles = 1.29;
- 175 to 200 miles = 1.25;
- 200 to 225 miles = 1.22;
- 225 to 250 miles = 1.15;
- 250 to 275 miles = 1.07; and
- For trips over 275 miles in length – adjustment factor = 1.00 (no adjustment).

The results of the trip distance adjustment factors are displayed in Figure 3.l. As shown, the application of the adjustment factors that varied by distance range improved the match between the adjusted and expanded LDTL trips and the

estimated trips from the daily diary data. After both sets of adjustment factors were applied, the adjusted and expanded LDTL trips summed to approximately 1.5 million daily intrastate, long-distance one-way trips, or an average of 8.2 annual long-distance round trips per capita. This value matched the 8.2 annual intrastate, long-distance round trips per capita estimated from the expanded CSHTS daily diary data.

Figure 3.1 Expanded Long-Distance Trips by Distance Range



Source: Cambridge Systematics, Inc.

4.0 Summary of the Adjusted 2012-2013 CSHTS Long-Distance Recall Survey Results

4.1 COMPARISON TO OTHER LONG-DISTANCE SURVEY DATA

The Peer Review Panel suggested that the overall results of the survey expansion and correction be compared to other data sources to demonstrate the reasonableness of the results. This analysis presents a comparison of the following data sources:

- 1995 ATS (long-distance trips are defined as greater than 100 miles);
- 2001 NHTS;
- 2009 NHTS (no separate long-distance component was collected);
- 2011 Harris Survey (long-distance trips only, interstate travel not included);
- 2012 CSHTS Daily Travel Diary;
- 2012 CSHTS LDTL – Uncorrected; and
- 2012 CSHTS LDTL – Corrected.

4.1.1 Overall Long-Distance Trip Rates

Table 4.1 presents a comparison of the long-distance trip rates from the data sources listed above. The data in this table are incomplete in some areas because the data collection methodologies and the definitions of long-distance trips are different. For example, the 1995 ATS defines long-distance trips as over 100 miles; the 2009 NHTS does not include a separate long-distance component; and both the 2000 HSRA model and the Harris Survey do not include short distance travel.

Table 4.1 Comparison of Annual Long-Distance Trip Rates per Household

Trip Length	1995 ATS	2001 NHTS	2009 NHTS	2000 HSRA Model 1	Harris Survey	CSHTS Daily Diary		CSHTS LD Travel Log (Corrected)	
				CA Only	CA Only	CA Only	Total USA	CA Only	Total USA
Total LD Trips (over 50 miles)		23.85		18.15	16.37	22.79	23.89	22.28	26.05
Over 100 miles	10.15	12.32		7.25	6.80	6.67	7.50	7.73	11.32
Over 300 miles	3.51	3.87		2.39	1.77	0.95	1.52	1.27	3.88
100 to 300 miles	6.64	8.45		4.85	5.02	5.71	5.98	6.46	7.44
50 to 100 miles		11.53		10.91	9.58	16.12	16.39	14.55	14.73
Daily Person Trips and Person Miles per Household (CSHTS Data Include Short Distance Trips from CSHTS Daily Diary)									
Person trips per household	10.49	9.66	9.50			9.96	9.96	9.94	9.97
PMT per household	94.41	95.24	90.42			62.09	67.61	58.23	81.49

Source: Cambridge Systematics, Inc.

Note: Analysis of the 1995 ATS, 2001 NHTS, and 2009 NHTS is presented in the NCHRP 735 Final Report.

This tabulation demonstrates that the corrections applied to the CSHTS LDTL dataset result in reasonable estimates of long-distance travel.

- For long-distance trips over 100 miles in length, the overall trip rate (11.32 annual trips per household) is close to the midpoint of the national data collected for the 1995 ATS (10.15 annual trips per household) and 2001 NHTS (12.32 annual trips per household);
- For long-distance trips over 300 miles in length, the overall trip rate (3.88 annual trips per household) is almost identical to the rate reported for the 2001 NHTS (3.87); and
- The trip rate for trips over 300 miles within California (1.27 annual trips per household) is significantly lower than the similar rate calculated for the 2011 Harris Survey (1.77).

4.1.2 Long-Distance Trip Length Frequency

The overall trip length frequencies for long-distance trips in 100-mile bins are compared in Table 4.2 across the three long-distance data sources available in the State of California. This table compares trip length frequency distributions for available sources: the 2000 High-Speed Rail Model, the 2011 Harris Survey, the CSHTS Daily Diary, the 2012 CSHTS LDTL (Uncorrected), and the 2012 CSHTS LDTL (Corrected). The data in this table illustrate the wide variation between

the data sources, and it demonstrates the need to validate observed data sources with other available data.

Table 4.2 Trip Length Frequency Distribution by 100 Mile Bins

Bin (Miles)	2000 CA HSRA Model Version 1		2011 Harris Survey		CSHTS Daily Diary		CSHTS LD Travel Log – Corrected	
	Expanded	Cum. %	Expanded	Cum. %	Expanded	Cum. %	Expanded	Cum. %
50 to 100	751,957	60.1%	660,278	58.5%	995,252	64.8%	1,003,404	65.3%
100 to 200	275,662	82.1%	277,832	83.1%	392,042	90.3%	373,266	89.6%
200 to 300	58,809	86.8%	68,600	89.2%	77,228	95.3%	72,025	94.3%
300 to 400	72,257	92.6%	89,892	97.1%	50,867	98.6%	61,683	98.3%
400 to 500	60,532	97.4%	28,579	99.7%	17,591	99.8%	22,266	99.8%
500 to 600	24,699	99.4%	3,249	100.0%	2,754	100.0%	2,871	100.0%
600 to 700	5,336	99.8%	369	100.0%	478	100.0%	647	100.0%
700 to 800	2,286	100.0%	0	100.0%	0	100.0%	39	100.0%
Total	**1,251,539**		**1,128,799**		**1,536,211**		**1,536,200**	

Source: Cambridge Systematics, Inc.

As discussed previously, the 2012 CSHTS LDTL provides the most comprehensive source of information regarding long-distance trips in California. Applying the adjustments documented in the previous section of this report results in overall long-distance trip generation and trip length frequency distributions that are much more reasonable, as compared to other data sources (2001 NHTS and 2012 CSHTS Daily Diary).

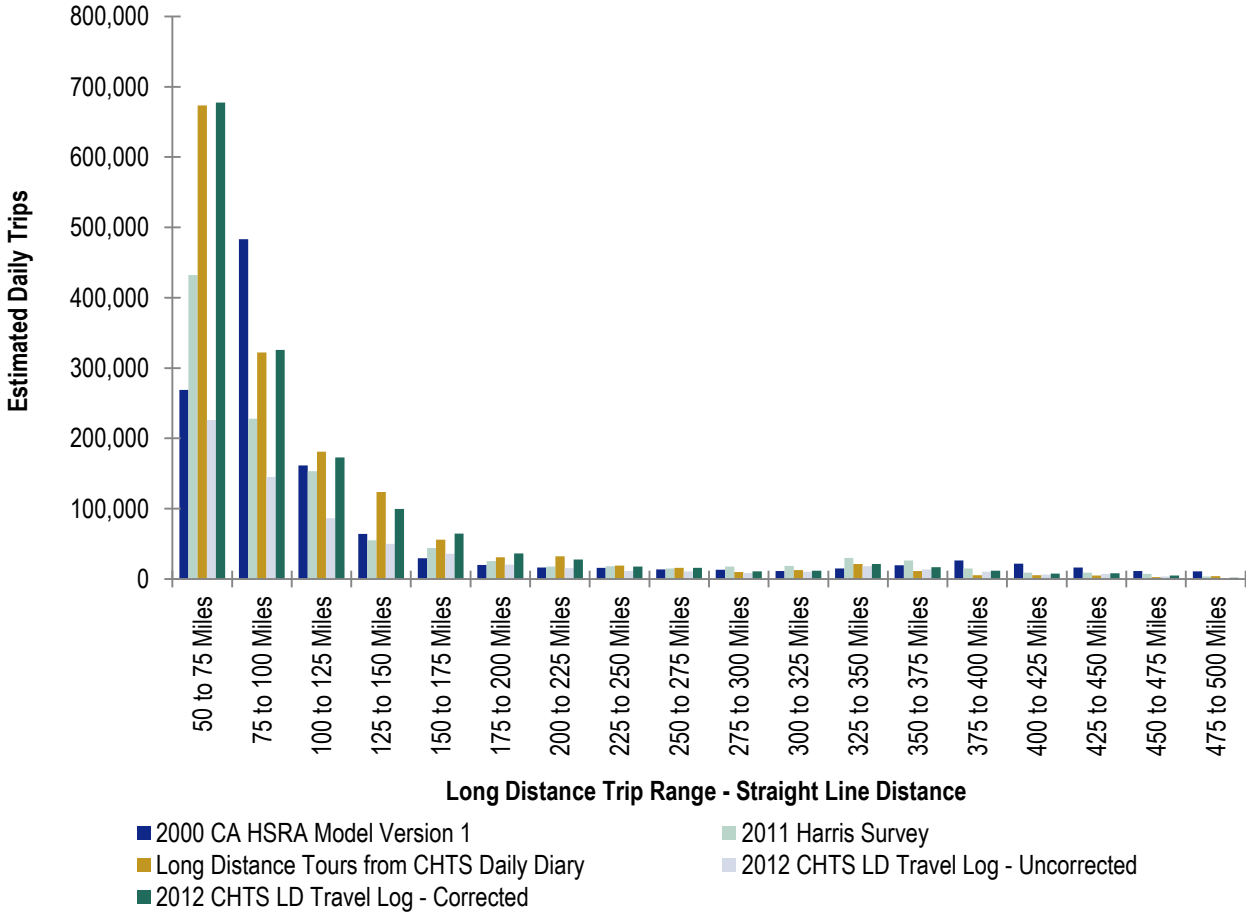
The overall trip length frequencies for long-distance trips in 25-mile bins are compared in Table 4.3 and Figure 4.1. Once again, these figures illustrate the wide variation in the data sources. The exhibits also demonstrate that the 2000 CAHSRA Model Version 1, which was validated using less comprehensive data and fewer independent data sources, varies from the data used to validate the current version of the CAHSRA Model, especially for long-distance trips of over 350 miles in length.

Table 4.3 Trip Length Frequency Distribution by 25 Mile Bins

Bin (Miles)	2000 CA HSRA Model Version 1		2011 Harris Survey		CSHTS Daily Diary		CSHTS LD Travel Log – Corrected	
	Expanded	Cum. %	Expanded	Cum. %	Expanded	Cum. %	Expanded	Cum. %
50 to 75	268,846	21.5%	432,213	38.3%	673,301	43.8%	677,640	44.1%
75 to 100	483,111	60.1%	228,065	58.5%	321,950	64.8%	325,764	65.3%
100 to 125	161,642	73.0%	153,331	72.1%	181,099	76.6%	172,690	76.6%
125 to 150	64,122	78.1%	54,838	76.9%	123,940	84.6%	99,485	83.0%
150 to 175	29,736	80.5%	44,271	80.9%	55,914	88.3%	64,544	87.2%
175 to 200	20,162	82.1%	25,393	83.1%	31,088	90.3%	36,547	89.6%
200 to 225	16,363	83.4%	17,868	84.7%	32,081	92.4%	27,611	91.4%
225 to 250	15,751	84.7%	18,270	86.3%	18,994	93.6%	17,784	92.6%
250 to 275	13,462	85.8%	14,899	87.6%	15,964	94.7%	15,950	93.6%
275 to 300	13,233	86.8%	17,562	89.2%	10,190	95.3%	10,681	94.3%
300 to 325	11,536	87.7%	18,424	90.8%	12,823	96.2%	11,992	95.1%
325 to 350	14,884	88.9%	30,053	93.5%	21,416	97.6%	21,192	96.5%
350 to 375	19,491	90.5%	26,296	95.8%	11,267	98.3%	16,649	97.5%
375 to 400	26,346	92.6%	15,118	97.1%	5,360	98.6%	11,850	98.3%
400 to 425	21,689	94.3%	9,168	98.0%	5,382	99.0%	7,711	98.8%
425 to 450	16,524	95.6%	8,945	98.8%	5,052	99.3%	7,984	99.3%
450 to 475	11,424	96.5%	7,049	99.4%	2,900	99.5%	4,874	99.7%
475 to 500	10,895	97.4%	3,417	99.7%	4,258	99.8%	1,696	99.8%
500 to 525	11,003	98.3%	968	99.8%	2,361	99.9%	1,406	99.9%
525 to 550	6,867	98.8%	530	99.8%	393	100.0%	834	99.9%
550 to 575	3,713	99.1%	1,036	99.9%	0	100.0%	106	99.9%
575 to 600	3,116	99.4%	714	100.0%	0	100.0%	525	100.0%
600 to 625	2,235	99.6%	210	100.0%	478	100.0%	398	100.0%
625 to 650	1,182	99.7%	29	100.0%	0	100.0%	31	100.0%
650 to 675	963	99.7%	110	100.0%	0	100.0%	69	100.0%
675 to 700	956	99.8%	21	100.0%	0	100.0%	149	100.0%
700 to 725	1,102	99.9%	0	100.0%	0	100.0%	23	100.0%
725 to 750	883	100.0%	0	100.0%	0	100.0%	16	100.0%
750 to 775	198	100.0%	0	100.0%	0	100.0%	0	100.0%
775 to 800	103	100.0%	0	100.0%	0	100.0%	0	100.0%
Total	**1,251,539**		**1,128,799**		**1,536,211**		**1,536,200**	

Source: Cambridge Systematics, Inc.

Figure 4.1 Trip Length Frequency Distribution for Long-Distance Trips



Source: Cambridge Systematics, Inc.

4.2 SURVEY RESULTS

This section presents descriptions of the tabulated results of the CSHTS LDTL, which were expanded and corrected to reflect long-distance travel in the State of California. Long-distance survey results are tabulated and displayed graphically to analyze trip frequency, trip length frequency, trip distribution, and mode shares. These data are classified by trip purpose, geographic region, socioeconomic characteristics, and group travel status to improve understanding of the observed long-distance travel behavior.

4.2.1 Long-Distance Trip Frequency

Following the adjustment of the 2012 to 2013 CHSTS Long-Distance Recall survey expansion, 1.536 million daily intrastate long-distance trips have been

estimated to be made by California residents. That level of trip-making represents an average of 8.2 annual long-distance round trips per capita.

4.2.1.1 Trip Frequency by Trip Purpose

The numbers and shares of trips by trip purpose are:

- 151,200 business trips (10 percent of total);
- 242,100 commute trips (16 percent);
- 512,100 recreational trips (33 percent); and
- 630,400 distance trips for other purposes (41 percent).

The annual intrastate long-distance average trip rate of 8.2 round trips per capita compares reasonably to the 9.4 annual long-distance round trip rate per capita reported in the NPTS Brief from 2006[4]. The reported NPTS rate included all long-distance trips, not just intrastate trips. For the Pacific region, the NPTS Brief reported an annual average of 8.7 long-distance round trips per capita. When interstate and international long-distance trips reported in the CSHTS daily diary are included in the analysis, the average annual long-distance round trip rate is 8.6 trips per capita.

4.2.1.2 Trip Frequency by Geographic Region

Table 4.4 summarizes the variation in average long-distance trip rates per capita by geographic region of the State. The average trip rates are generally higher in rural areas of the State and lower in urban areas. Average trip rates for the four largest urban areas of the State vary from 7.2 to 8.4 annual long-distance round trips per capita. In contrast, average annual round trip rates per capita in more rural areas of the State are greater than 10 trips per capita.

Table 4.4 Average Annual Intrastate Round Trips per Capita by Geographic Region

Home Region	Average Annual Long-Distance Round Trips per Capita
Southern California (SCAG) Region	7.2
Bay Area (MTC) Region	8.4
San Diego (SANDAG) Region	7.8
Sacramento (SACOG) Region	7.5
San Joaquin Valley Counties	11.6
Rest of State	10.1
Statewide	8.2

Source: Cambridge Systematics, Inc.

[4] *Ibid*. 1.

4.2.1.3 Trip Frequency by Socioeconomic Characteristics

Table 4.5 presents a tabulation of long-distance trips for various important socioeconomic classifications, cross-classified by trip purpose. This tabulation demonstrates that the most powerful variables for explaining long-distance travel behavior are household income and auto availability (i.e., residents with higher incomes or more vehicles are more likely to make long-distance trips than residents with lower incomes or fewer automobiles available).

Table 4.5 Annual Long-Distance Trip Rates by Socioeconomic Characteristics

	Annual Long-Distance Round Trip Rates per Capita				
Value	**Business**	**Commute**	**Recreation**	**Other**	**Total**
Variable: Household Size					
1	1.23	2.25	2.75	5.12	**11.35**
2	1.19	1.60	3.21	4.39	**10.39**
3	0.78	1.39	2.41	3.14	**7.71**
4+	0.58	0.97	2.64	2.71	**6.90**
Total	0.80	1.29	2.73	3.35	**8.17**
Variable: Number of Workers					
0	0.49	0.44	2.19	4.10	**7.21**
1	0.82	1.51	2.73	3.42	**8.48**
2+	0.90	1.40	2.91	3.03	**8.25**
Total	0.80	1.29	2.73	3.35	**8.17**
Variable: Number of Vehicles					
0	0.25	0.16	1.53	2.01	**3.94**
1	0.67	1.10	2.07	3.55	**7.39**
2+	0.89	1.44	3.04	3.40	**8.77**
Total	0.80	1.29	2.73	3.35	**8.17**
Variable: Income Range					
Low	0.37	0.21	1.55	2.80	**4.94**
Med	0.76	1.69	2.46	3.51	**8.43**
High	1.08	1.63	3.57	3.56	**9.84**
Total	0.80	1.29	2.73	3.35	**8.17**

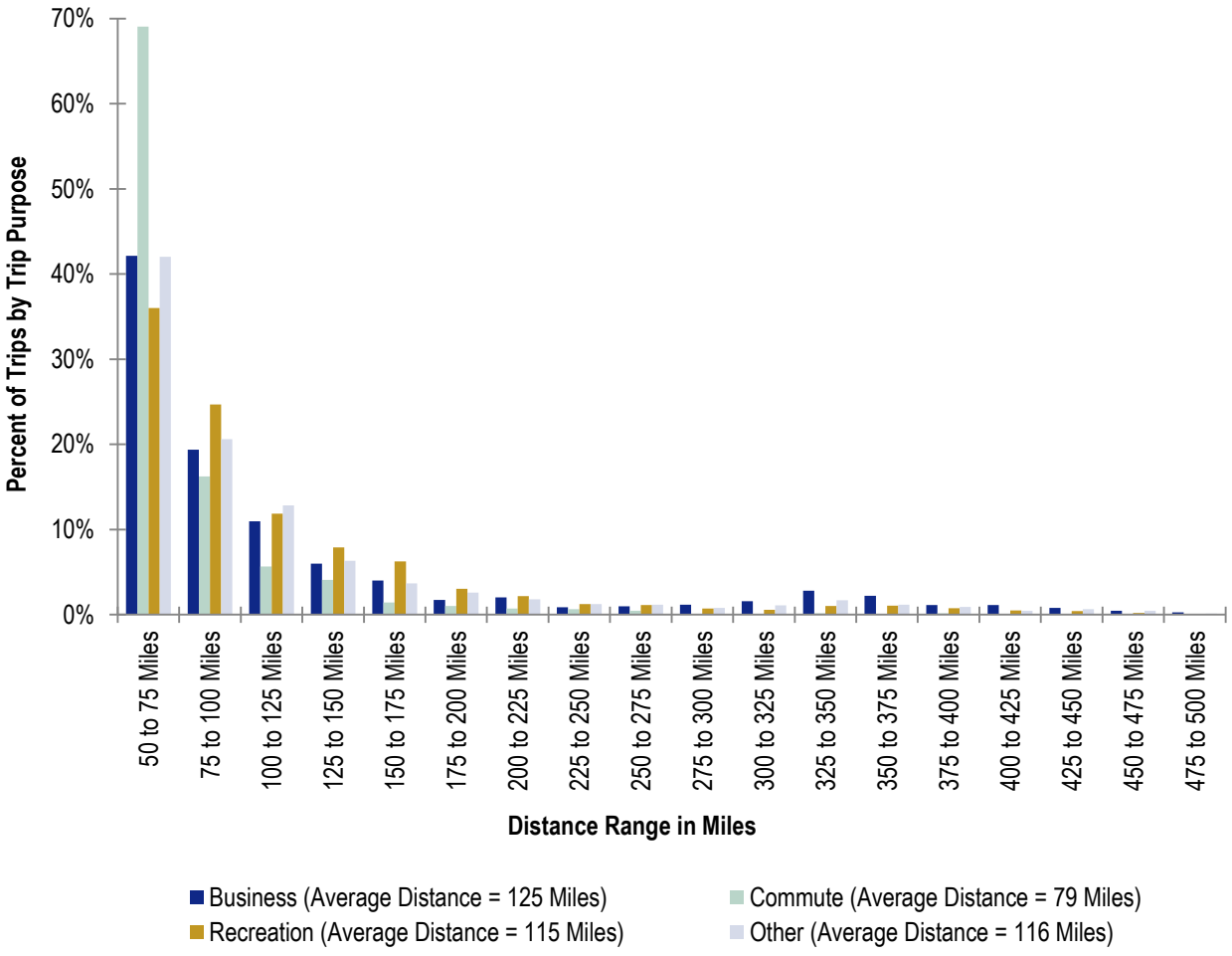
Source: Cambridge Systematics, Inc.

4.2.2 Long-Distance Trip Length and Trip Distribution

4.2.2.1 Trip Length Frequency by Trip Purpose

Figure 4.2 displays the trip length frequency distributions of long-distance trips by trip purpose within California. The shares of commute trips decrease most rapidly with increasing trip distance, while the other three trip purposes show similar decreases in shares with increasing trip distances. The trip length frequency distributions for the business, recreation, and other trip purposes show a slight "hump" in shares in the 300- to 375-mile distance range. That slight increase in trips in that distance range reflects travel between the major metropolitan areas in Northern California – the San Francisco and Sacramento areas – and the major metropolitan areas in Southern California – the Los Angeles and San Diego areas.

Figure 4.2 Long-Distance Trip Length Distribution by Purpose



Source: Cambridge Systematics, Inc.

The average straight line distance between origin and destination locations for all long-distance trips within California has been estimated to be 111 miles. Long-distance trips lengths vary by trip purpose with commute trips being the shortest (79 miles) and business trips being the longest (127 miles). Average trip distances for recreational and other trip purpose are both approximately 115 miles.

4.2.2.2 Trip Distribution by Geographic Region

We tabulated observed/expanded long-distance trips between six regions in the State of California and present the tabulated data in Table 4.6. This data are expressed in "production to attraction" format, so that the directionality of travel between regions can be understood. These data show that the larger urbanized areas, SCAG and MTC, are both net producers of long-distance trips. This may seem counterintuitive, since regional travel models typically exhibit a net external-to-internal traffic flow across external cordons, especially in peak commute periods. However, since the majority of long-distance travel is associated with recreational and other nonwork trip purposes, it is understandable that long-distance travel flow follows the patterns of recreational travel behavior (i.e., trips from population centers to recreation areas such as the coastline or the mountains).

Table 4.6 Daily Long-Distance Trips between Regions

	To Region						
From Region	**SCAG**	**MTC**	**SANDAG**	**SACOG**	**SJ Valley**	**Rest**	**Total**
SCAG	358,556	24,004	162,119	7,397	36,109	66,854	655,038
MTC	22,422	73,067	5,648	77,210	30,385	93,773	302,505
SANDAG	101,611	4,465	2,834	1,440	4,406	7,569	122,326
SACOG	4,624	41,346	1,039	11,138	6,577	23,723	88,448
San Joaquin Valley	52,039	51,037	3,434	19,389	56,306	49,904	232,109
Rest of State	15,315	46,762	1,645	20,195	11,354	40,030	135,302
Total	**554,567**	**240,682**	**176,720**	**136,769**	**145,137**	**281,853**	**1,535,728**

Source: Cambridge Systematics, Inc.

In Table 4.7, we tabulated the major flows between regions in California.

- This table shows that more than one-half of long-distance travel produced by the sprawling SCAG region is destined for locations that also are within the SCAG region;
- The most popular source of interregional travel is between the adjacent Southern California urban areas – SCAG and SANDAG – followed by the adjacent Northern California urban areas – MTC and SACOG; and

- The most popular source of interregional travel between nonadjacent regions is observed, as we would expect, between the SCAG and MTC regions.

Table 4.7 Major Long-Distance Flows between Regions

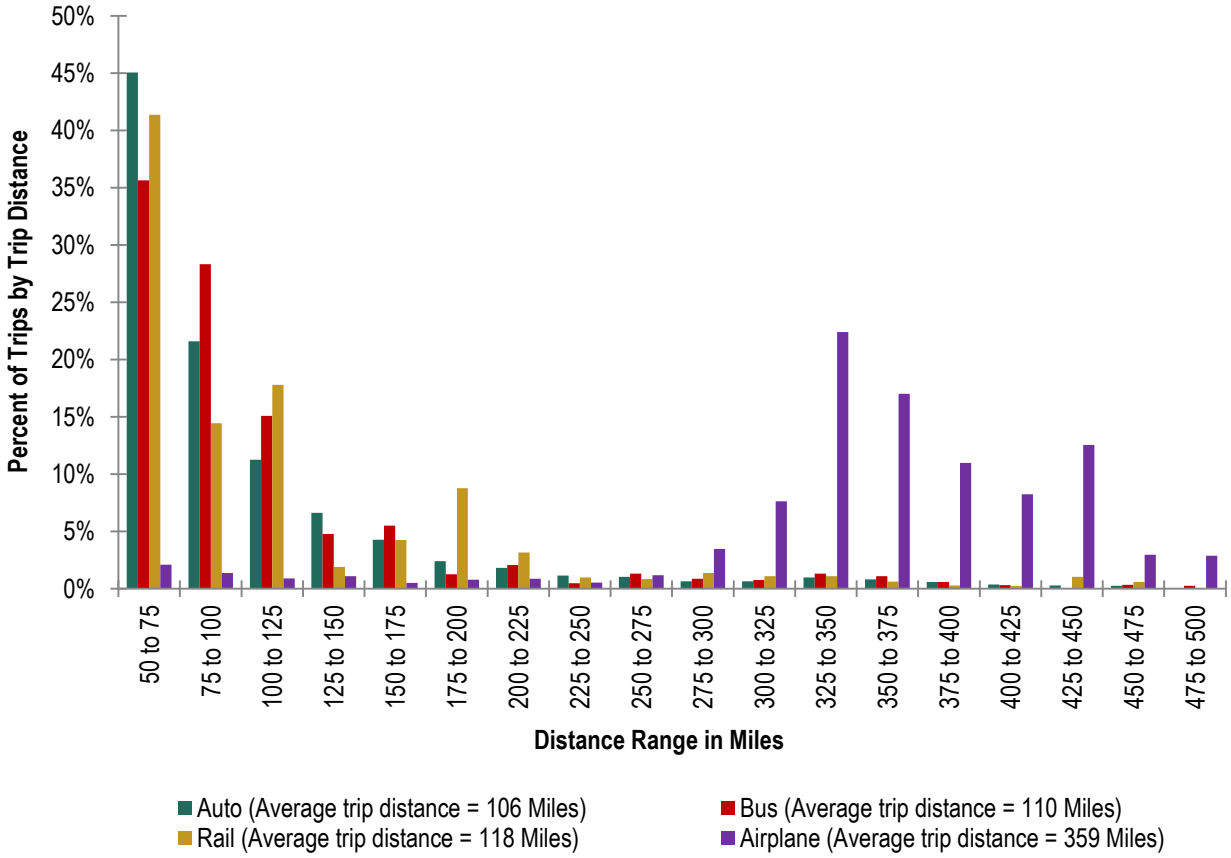
	LD Travel Log		
Major Flows	**Daily Long-Distance Trips**	**Total Productions**	**Percent of Total Productions on Major Flow**
Intra-SCAG	358,556	655,038	55%
Intra-MTC	73,067	302,505	24%
Intra-SJV	56,306	232,109	24%
Intra-SACOG	11,138	88,448	13%
Intra-SANDAG	2,834	122,326	2%
SCAG to SANDAG	162,119	655,038	25%
SCAG to SJV	36,109	655,038	6%
SCAG to MTC	24,004	655,038	4%
SCAG to SACOG	7,397	655,038	1%
MTC to SACOG	77,210	302,505	26%
MTC to SJV	30,385	302,505	10%
MTC to SCAG	22,422	302,505	7%
SJV to MTC	51,037	232,109	22%
SJV to SCAG	52,039	232,109	22%
SJV to SACOG	19,389	232,109	8%
SACOG to MTC	41,346	88,448	47%
SACOG to SJV	6,577	88,448	7%
SACOG to SCAG	4,624	88,448	5%
SANDAG to SCAG	101,611	122,326	83%

Source: Cambridge Systematics, Inc.

4.2.2.3 Trip Length Frequency by Main Travel Mode

Figure 4.3 shows the trip length frequency distributions by main travel mode within California. As would be expected, the shares of trips by auto and bus decrease rapidly and smoothly with increasing distance.

Figure 4.3 Long-Distance Trip Length Distribution by Mode



Source: Cambridge Systematics, Inc.

Shares of trips by rail also decrease rapidly, but less smoothly, with increasing distance. The trip length distribution probably reflects two different types of rail travel: commuter rail within the San Francisco, Los Angeles, and San Diego metropolitan regions (for trips between 50 and 100 miles); and intercity rail travel between urban areas such as Sacramento and San Francisco or San Diego and Los Angeles (for trips over 100 miles). We should note that only 213 long-distance rail trips were reported in the CSHTS LDTL, and expanded to represent long-distance rail travel in the State of California.

The trip length frequency distribution for air travel displays peaks between 300 and 450 miles, which reflects the travel distances between the major metropolitan areas in Northern and Southern California.

4.2.3 Long-Distance Mode Shares

4.2.3.1 Mode Share by Trip Purpose

Table 4.8 summarizes long-distance mode shares by trip purpose. As would be expected, auto is the dominant mode for all trip purposes. It is interesting to note that bus mode shares are similar to those for rail for all trip purposes. Airplane mode is much more popular for business travel (over six percent) than for other trip purposes.

Table 4.8 Long-Distance Mode Shares by Trip Purpose

	Main Travel Mode			
Trip Purpose	**Auto**	**Bus**	**Rail**	**Airplane**
Business	91.5%	0.9%	1.4%	6.2%
Commute	97.9%	1.0%	0.9%	0.2%
Recreation	97.3%	1.0%	0.9%	0.9%
Other	96.1%	1.3%	1.1%	1.4%
All Purposes	**96.3%**	**1.1%**	**1.0%**	**1.5%**

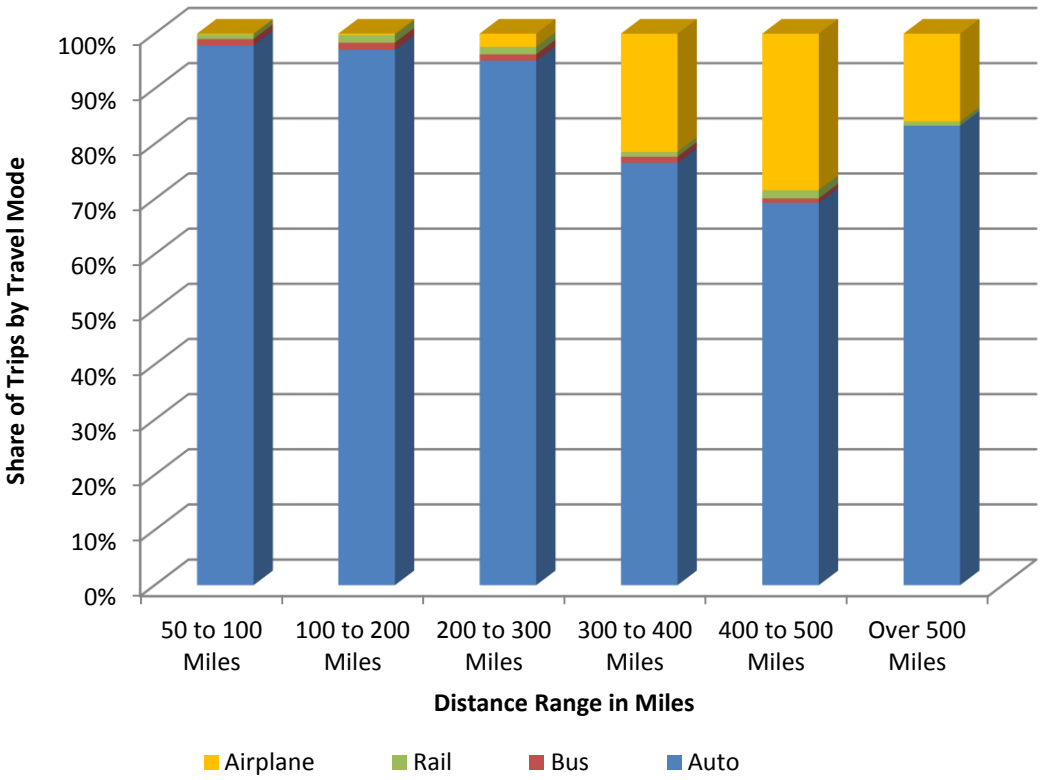
Source: Cambridge Systematics, Inc.

4.2.3.2 Mode Share by Trip Distance

Figure 4.4 summarizes long-distance mode shares by trip distance range. The figure also demonstrates the dominance of the auto mode for all distance ranges. However, the figure also shows that air travel captures significant portions of the travel market in the distance ranges over 300 miles.

As discussed previously, it is important to note that the airplane mode shares are significantly lower for this analysis, based on the 2012 CSHTS LDTL, than for the survey data previously documented for the 2011 Harris Survey. The 2012 CSHTS LDTL expanded and corrected shows an average airplane mode share of 27 percent for trips over 300 miles, while the 2011 Harris Survey expanded shows an average airplane mode share of 34 percent for trips over 300 miles.

Figure 4.4 Long-Distance Mode Shares by Trip Length



Source: Cambridge Systematics, Inc.

4.2.3.3 Mode Share by Area Type

We tabulated main mode shares for long-distance travel according to the model's area type coded for both the production (home) and attraction TAZ for long-distance trips. The data tabulated in Table 4.9 show that:

- There is a strong correlation between mode choice and area type at the production end, and that the correlation is even stronger at the attraction end;
- Airplane mode shares for long-distance travel are consistently higher for higher density area types; and
- Rail mode shares are significantly higher for long-distance travel to attractions in central business district (CBD) areas.

Table 4.9 Long-Distance Mode Shares by Area Type

	Main Travel Mode			
	Auto	**Bus**	**Rail**	**Airplane**
Area Type of Production TAZ				
Rural	97.2%	1.1%	0.5%	1.2%
Suburban	96.7%	0.7%	1.3%	1.3%
Urban	94.7%	1.4%	1.6%	2.3%
CBD Fringe	93.2%	1.8%	0.9%	4.2%
CBD	91.3%	3.0%	1.4%	4.4%
Total	96.1%	1.1%	1.0%	1.7%
Area Type of Attraction TAZ				
Rural	97.9%	1.0%	0.5%	0.5%
Suburban	96.8%	1.0%	0.8%	1.4%
Urban	96.3%	1.1%	0.6%	2.0%
CBD Fringe	92.8%	1.3%	1.6%	4.3%
CBD	88.6%	1.9%	4.6%	5.0%
Total	**96.1%**	**1.1%**	**1.0%**	**1.7%**

Source: Cambridge Systematics, Inc.

4.2.3.4 Mode Share by Group Travel

We tabulated the main travel mode shares for long-distance travel according to the group size data reported by survey respondents. The data tabulated in Table 4.10 show that there is a strong correlation between mode choice and group travel. Auto mode is much more popular for group travel. The higher auto mode shares for travel in groups are expected given the ability to share costs for auto travel; whereas, similar cost savings typically are not available for group travel.

Table 4.10 Long-Distance Mode Shares by Group Status

	Main Travel Mode			
Group Type	**Auto**	**Bus**	**Rail**	**Airplane**
Alone	92.8%	1.8%	2.2%	3.2%
Group	97.8%	0.8%	0.4%	1.0%
Total	**96.1%**	**1.1%**	**1.0%**	**1.7%**

Source: Cambridge Systematics, Inc.

4.3 COMPARISON TO OBSERVED RIDERSHIP DATA

This section presents comparisons of the expanded CSHTS Long-Distance Recall survey data to observed ridership data for the rail and airplane travel modes.

4.3.1 Comparison with Rail Ridership Data

Amtrak provided city-to-city ridership data that are collected from ticket purchases. These data can be used to check the reasonableness of the rail ridership estimates from the expanded/corrected CSHTS Long-Distance survey data. Using straight line distances between stations, we were able to eliminate trips that were less than 50 miles and do not qualify as long-distance trips.

Table 4.11 presents a comparison of the total ridership estimates from the Amtrak data (and ACE ridership between the San Joaquin Valley and MTC region) and the rail ridership estimates from the expanded/corrected CSHTS Long-Distance survey. As this tabulation shows, the results were remarkably similar, especially considering how few observed records of rail travel were used to generate the CSHTS estimates. For example, the estimate of long-distance rail travel between the SANDAG and SCAG regions was based on expanded/corrected from 44 survey records, and the resulting estimates are within one percent of each other.

Overall, the CSHTS data are within three percent of matching the total volume of long-distance travel for the seven regional pairs tabulated in Table 4.11. This is evidence that, in spite of the small number of rail trips observed in the CSHTS Long-Distance survey, the resulting expanded/corrected data provide a reasonably well validated source of data.

Table 4.11 Comparison of Daily Long-Distance Rail Ridership Estimates

Regions	Route(s)	Total Riders	Percent Less than 50 Miles	LD Riders	CSHTS LD Survey	Ratio
SANDAG-SCAG	Pacific Surfliner	4,345	8%	3,998	3,951	99%
SACOG-MTC	Capitol Corridor	3,641	11%	3,241	2,672	82%
SCAG-Central Coast	Pacific Surfliner	1,047	10%	942	1,634	173%
SJV-MTC	San Joaquin, ACE	2,418	40%	961	951	99%
MTC-SCAG	Coast Starlight	500[a]	0%	500[a]	600	120%
SANDAG-Central Coast	Pacific Surfliner	316	0%	316	444	141%
SJV-SACOG	San Joaquin	316	9%	287	336	117%
Total		**12,583**		**10,244**	**10,587**	**103%**

Source: Cambridge Systematics, Inc.

[a] Estimate. City-to-city data not available for this route.

4.3.2 Comparison with Airplane Passenger Data

Air passenger data are available from the ticket data reported by airlines to the U.S. Department of Transportation (DOT) and available from the Bureau of Transportation Statistics (BTS) web site. These data include the database referred to as DB1B or the 10 percent O&D Survey.

This data source was analyzed by Aviation System Consulting, LLC, who estimated that in 2009 (the most recent year available at the time) over 12.5 million passengers traveled between major airports in Northern California (MTC and SACOG regions) and Southern California (SCAG and SANBAG regions). This equates to over 34,000 air passengers per day, as displayed in Table 4.12. However, the air passenger estimates from the expanded/corrected CSHTS Long-Distance survey identify only 19,000 air passengers per day, 55 percent of the total estimated from the 10 percent O&D Survey. CSHTS data for all four regional markets between northern California and southern California are significantly less than the 10 percent O&D Survey data.

Table 4.12 Comparison of Daily Long-Distance Air Passenger Estimates

Regions	Passenger Count (2009)	2012 CSHTS LD Expanded	Ratio
MTC-SCAG	20,419	11,836	58%
MTC-SANDAG	6,495	4,201	65%
SACOG-SCAG	5,594	2,436	44%
SACOG-SANDAG	1,858	563	30%
Major Market Total	**34,366**	**19,035**	**55%**

Sources: Aviation System Consulting, LLC and Cambridge Systematics, Inc.

We have tested several hypotheses to try to explain this difference, but have yet to find an explanation that can account for the full magnitude of the difference. A portion of the difference can be explained by out-of-state visitors traveling within California, but this certainly does not account for the full difference. As documented previously, the comparison of the CSHTS Long-Distance survey to the Harris Survey completed in 2011 shows a difference between the two surveys in the number of long-distance air passengers on trips over 300 miles in length. The 2012 CSHTS LDTL expanded and corrected shows an average airplane mode share of 27 percent for trips over 300 miles, while the 2011 Harris Survey expanded shows an average airplane mode share of 34 percent for trips over 300 miles.

We have not identified any systemic bias that would explain this difference. Our first inclination would be to assume that the differences result because the panels used for the Harris Survey were biased to oversample older and higher income residents who are more likely to choose air travel for their main travel mode. However, the comparison of the expanded data to air passenger data collected in

California indicates that the Harris Survey better reflects actual air passenger travel than the CSHTS data. We believe that the low volumes of airplane travel identified in the CSHTS reflect a statistical outlier that will be corrected in the final validation of the long-distance models.

5.0 Summary

The data collected and tabulated in this report are being used to validate the performance of the Version 2 CHSR3M. Our understanding of long-distance travel markets in the State of California has increased greatly by contrasting the three available data sources on long-distance travel in California with the 1995 ATS, the 2001 NHTS, and to a lesser extent the 2009 NHTS.

This report also has demonstrated the difficulties associated with collecting long-distance travel data. Typical household travel survey techniques employing daily travel diaries and an assigned travel day are inadequate and inefficient for collecting data on long-distance travel due to the low incidence of long-distance trip-making. In California, the travel data collected via the use of a one day diary by over 100,000 people in almost 40,000 households yielded only about 4,000 long-distance trips. Even if sufficient data can be collected, a standard one-day travel diary survey will not provide good information since many long-distance trips span more than one day. Thus, without special probing, the purpose for the long-distance trip is frequently missed using a one-day diary.

Long-distance trip recall diaries are generally required to collect information on long-distance travel. Nevertheless, the recall diaries must be well designed to ensure that information on long-distance travel is not systematically missed. The provision of adequate space on survey logs to record all long-distance trips, and the provision of a shortcut method for reporting multiple trips to the same destination for the same purpose and using the same travel mode are of particular importance.

The key finding is that the adjusted trip rates based on the CSHTS survey result in a total of 1.5 million daily one-way long-distance trips. This corresponds to an average of 8.2 annual intrastate long-distance round trips per capita for California household residents. In comparison, the NPTS Brief from 2006[5] estimated the national average of 9.4 annual long-distance round trips per capita; for the Pacific region, the annual average was 8.7 long-distance round trips per capita. When interstate and international long-distance trips reported in the CSHTS daily diary also are included in the analysis, the average round trip rate is 8.6 annual long-distance round trips per capita, which is almost identical to the value reported in the NPTS for the Pacific region.

[5] *Ibid.* 1.